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ABSTRACT

The document is a student resource unit to be used in teaching high school vocational agriculture students about the environment. The relationship between ecology and changes in the ecosystems induced by man are discussed. The kinds of environmental problems treated are pollution, land use, and natural resources. Some causes of environmental problems described are population (control and mobility), values, technology, misdirected economic incentives, and limitations of government, laws, and enforcement. Long-term effects of environmental deterioration are to be found in health, ecosystems, economic costs, esthetics, and recreation. Promising sources of solutions to these problems lie in citizen participation, environmental education, and government programs. Some present and future environmental needs are described. A 36-item bibliography concludes the document. (MS)

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## *Ag Ed Environmental Education Series*

# *UNDERSTANDING THE ENVIRONMENT*

*WASHINGTON STATE UNIVERSITY IN COOPERATION WITH THE COORDINATING COUNCIL FOR OCCUPATIONAL EDUCATION.*

73-3G

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Palouse Country
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*Environmental Education Series*

- Air
- Agricultural Chemicals and Radiation
- Animals
- Land Use
- Noise
- Plants
- Understanding the Environment
- Water

ED 084427

# UNDERSTANDING THE ENVIRONMENT

by
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## FOREWORD

This publication is the product of a project carried on by the Coordinating Council for Occupational Education and the Department of Education, Washington State University.

The project grew out of a recognition of the need to include as a part of the high school vocational agriculture curriculum information dealing with the environment, particularly as it relates to agriculture. The project was preceded by a period of growing concern that a body of factual information and teacher resources needed to be developed in this area.

E. M. Webb, associate professor of agricultural education emeritus, first suggested that steps be taken to make available to teachers of agriculture and their students factual information on the environment and agriculture. It was through the efforts of Jay Wood, program director, agricultural education, Olympia, that a project was prepared and approved beginning in September 1970.

Valuable assistance was given the project by many persons from the following agencies: Washington State University, University of Washington, Western Washington State College, Soil Conservation Service, United States Department of Agriculture, United States Department of the Interior, Washington Parks and Recreation Department, Washington Department of Ecology, Washington Department of Natural Resources, Washington Department of Agriculture, Washington Department of Fisheries, Washington Water Pollution Control Commission, Environmental Protection Agency, and Washington Department of Game. Many other agencies provided information for the project.

Three publications were extremely useful in preparing this unit. They were *Environmental Quality: The First Annual Report of the Council on Environmental Quality*, *Environmental Quality: The Second Annual Report of the Council on Environmental Quality*, and *Wastes in Relation to Agriculture and Forestry*. Information from these publications was used as a basis for much of this unit.

Grateful acknowledgment is hereby made to the following groups of people: Dr. C. O. Loreen and Dr. Keith E. Fiscus, both teacher-educators and state supervisors in agricultural education, and Mr Jay M. Wood, program director, agricultural education, who gave able assistance to this endeavor. Mr. Ronald Crawford, Mrs. Patricia Freeman, Mr. Harold Gilkey, and Mr. Glen Puterbaugh, teachers of agricultural education in Washington high schools, reviewed the unit, developed teaching materials to be used with the unit, and taught the unit to their students. Many other teachers also made valuable contributions to the project.

The following subject-matter specialists reviewed the unit: Dr. Carl Goebel, chairman, environmental science program, Washington State University; Mr. Clar Pratt, public relations, Washington Department of Ecology; and Dr. Gerald Young, assistant professor of geography and environmental science, Washington State University.

This unit is one of eight being produced under the project. The other seven include: *Land Use, Water, Noise, Agricultural Chemicals and Radiation, Animals, Plants,* and *Air*.

July 1972

Rodney W. Tulloch

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# INTRODUCTION

In his Presidential Message to Congress in August 1970, President Richard M. Nixon said the following:

> Environment is not an abstract concern, or simply a matter of esthetics, or of personal taste although it can and should involve these as well. Man is shaped to a great extent by his surroundings. Our physical nature, our mental health, our culture and institutions, our opportunities for challenge and fulfillment, our very survival all of these are directly related to and affected by the environment in which we live. They depend upon the continued healthy functioning of the natural systems of the earth.
>
> Environmental deterioration is not a new phenomenon. But both the rate of deterioration and its critical impact have risen sharply in the years since the Second World War. Rapid population increases here and abroad, urbanization, the technology explosion, and the patterns of economic growth have all contributed to our environmental crisis. While growth has brought extraordinary benefits, it has not been accompanied by sufficiently foresighted efforts to guide its development.
>
> At the same time, in many localities, determined action has brought positive improvements in the quality of air or water demonstrating that, if we have the will and make the effort, we can meet environmental goals. We also have made important beginnings in developing the institutions and processes upon which any fundamental, long-range environmental improvement must be based.
>
> The basic causes of our environmental troubles are complex and deeply imbedded. They include: our past tendency to emphasize quantitative growth at the expense of qualitative growth; the failure of our economy to provide full accounting for the social costs of environmental pollution; the failure to take environmental factors into account as a normal and necessary part of our planning and decisionmaking; the inadequacy of our institutions for dealing with problems that cut across traditional political boundaries; our dependence on conveniences, without regard for their impact on the environment; and more fundamentally, our failure to perceive the environment as a totality and to understand and to recognize the fundamental interdependence of all its parts, including man himself.
>
> It should be obvious that we cannot correct such deep-rooted causes overnight. Nor can we simply legislate them away. We need new knowledge, new perceptions, new attitudes and these must extend to all levels of Government and throughout the private sector as well: to industry; to the professions; to each individual citizen in his job and in his home. We must seek nothing less than a basic reform in the way our society looks at problems and makes decisions.
>
> Our educational system has a key role to play in bringing about this reform. We must train professional environmental managers to deal with pollution, land planning, and all the other technical requirements of a high-quality environment. It is also vital that our entire society develop a new understanding and a new awareness of man's relation to his environment what might be called environmental literacy. This will require the development and teaching of environmental concepts at every point in the educational process.
>
> While education may provide ultimate answers to long-range environmental problems, however, we cannot afford to defer reforms which are needed now. We have already begun to provide the institutional framework for effective environmental improvement.

A few persons have long been vitally aware and concerned with the deterioration of the environment. These people were often referred to as conservationists. During its earlier days, the conservation movement was mainly concerned with conservation of renewable resources. As more people became concerned and a better understanding of the problem of our environment was reached, the conservation or environmental movement broadened greatly. Man's total environment, with an emphasis on pollution, population, ecology, and even the urban environment, has become more generally recognized.

The public has become much more aware of the interrelationship of all living things. The publication of many books, articles, and TV documentaries began to arouse the public's curiosity as to what was happening to their environment. The importance of a single accident in blighting a large area was seen in 1969 with the Santa Barbara oil spill. Since then, many environmental issues have reached the headlines: the SST, the jetport near Everglades National Park, and the proposed pipeline across the Alaskan wilderness. Other issues include the pollution of many lakes, including Lake Erie, polluted beaches, and increasing smog problems. Issues such as lead in gasoline, phosphates in detergents, and the use of DDT have received wide publicity. Millions of persons have come to realize that the interdependent web of life, including man, animals, plants, earth, air, water, and sunlight, touches everyone.

Publicity about the deterioration of our environment has raised both the curiosity and awareness of Americans. As we become more aware of the problems in our environment, we want to know the full extent of the environmental crisis and the nature of the factors that have contributed to it. From this unit it is hoped that a general understanding of the interrelationships and complexities of man and his environment will emerge.

## ECOLOGY AND CHANGE

Ecology is the science or study of the intricate web of relationships between living organisms and their living and nonliving surroundings. These interdependent living and nonliving parts make up ecosystems. Forests, lakes, and estuaries are examples. Larger ecosystems or combinations of ecosystems, which occur in similar climates and share a similar character and arrangement of vegetation, are biomes. The arctic tundra, prairie grasslands, and the desert are examples. The earth, its surrounding envelope of life-giving water and air, and all its living things comprise the biosphere. Finally, man's total environmental system includes, not only the biosphere, but also his interactions with his natural and man-made surroundings.

Changes in ecosystems occur continuously (fig. 1). Interactions take place every moment of the day as plants and animals respond to variations in their surroundings and to each other. Species can adjust to changes in their surroundings. These changes must, however, fall within certain ranges, and the more rapid the change the more likely a species is to have problems adapting. Thousands of species in an ecosystem, or millions of species in the biosphere, continually adjust to outside stimuli. These interactions are so numerous and so interrelated that they form long chains of reactions. This makes it possible for small changes in one part of an ecosystem to be felt and compensated for throughout the system. Thus, the long-term effects are often very difficult to predict.

Many examples of change caused by man can be seen in the environment. One such example is the Aswan Dam, which was built primarily to generate electric power. The dam has been successful in producing power, but it has also reduced the fish population in the Mediterranean, increased the numbers of disease-bearing aquatic snails, and markedly lowered the fertility of the Nile Valley. An example a little closer to home is the building of the St. Lawrence Seaway. The construction of this seaway has contributed to the economic growth of the Great Lakes region. However, completion of the Welland Canal let the predatory sea lamprey into the Great Lakes via the seaway. Trout and other large predatory fish became nearly extinct because of the attack of the sea lamprey. The fishing industry

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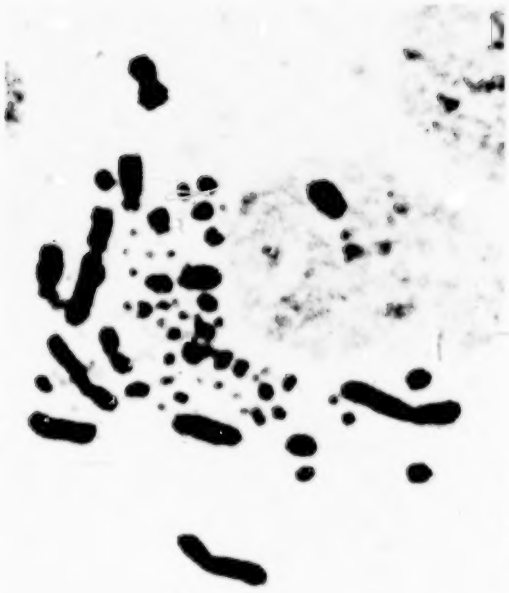

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*Fig. 1.—USDA scientists pluck feather from sandhill crane (left) for chromosome count. Electron micrograph (right) shows chromosomes in the feather pulp. Such studies may save the whooping crane and other wild birds from extinction. By careful breeding scientists seek to overcome genes that make a species unable to adapt to the changing world. Another potential result: major improvements in domestic fowl.*

suffered greatly. Because these predatory fish were removed, smaller fish such as the alewife, which were usually eaten by these predators, now increased in great numbers. The aggressive alewife soon dominated the food supply and greatly reduced the numbers of the remaining native fish, such as the lake herring. As the alewife became very numerous, large numbers of them died and left dead fish along the shore, which caused a major public nuisance.

There were attempts made to help restore the ecological balance by controlling the sea lamprey. Then the lakes were stocked with coho salmon beginning in 1965. These salmon were to replace the lost native predatory fish. Since the alewife was abundant, the salmon ate them and multiplied rapidly and by 1969 had become important both as a commercial and sport fishing resource. Just about the time that it seemed the problem was being solved, some of the salmon were found to contain concentrations of DDT or related compounds and were taken off the commercial market. This, of course, would have happened without the seaway.

It is important to realize that we should not necessarily stop construction of canals, dams, or other construction; however, it is important that the consequences of construction, including its effect upon the environment, be studied much more carefully in the future. We must begin to appreciate the enormous interrelated complexity of environmental systems. We then need to look at the alternatives available to us. This will include a careful weighing of the tradeoffs between potential environmental harm and the benefits of construction. We should also incorporate environmental safeguards into the basic design of new developments.

Much of our economic growth has taken place through the use of resources. In the process, many of these resources are turned into wastes. It is possible to take the optimistic view that these wastes are merely resources for which we have not found a use. Such an optimistic view offers hope that, as knowledge is increased, we will develop adequate technology along with the proper economic and legal constraints to solve many of our environmental problems involved in production. While optimism may be very useful, it is necessary that we look realistically at the problem of attaining such goals.

In our society, the profit motive is the basis of much of what is done. Thus, net profit is a key guideline in making our decisions. Depletion of a resource is often viewed only as to the economic effects of obtaining alternates. However, in the process of using these resources, they often become part of the increasing waste problem.

Let us look at an agricultural example. Only a few decades ago manure was valued as a resource. Its use in building soil fertility was widely acclaimed. Much technical information was available on proper handling to obtain maximum benefits on the land. A few persons, including people in the Pennsylvania Dutch region, still carefully use their manure to maintain their highly productive lands. These people are, however, unusual in that they have virtually a religious dedication to conserving and improving their land and their farms. They are, first of all, devoted stewards of the land and, secondly, participants in the marketplace. They have no problems on how to dispose of animal waste.

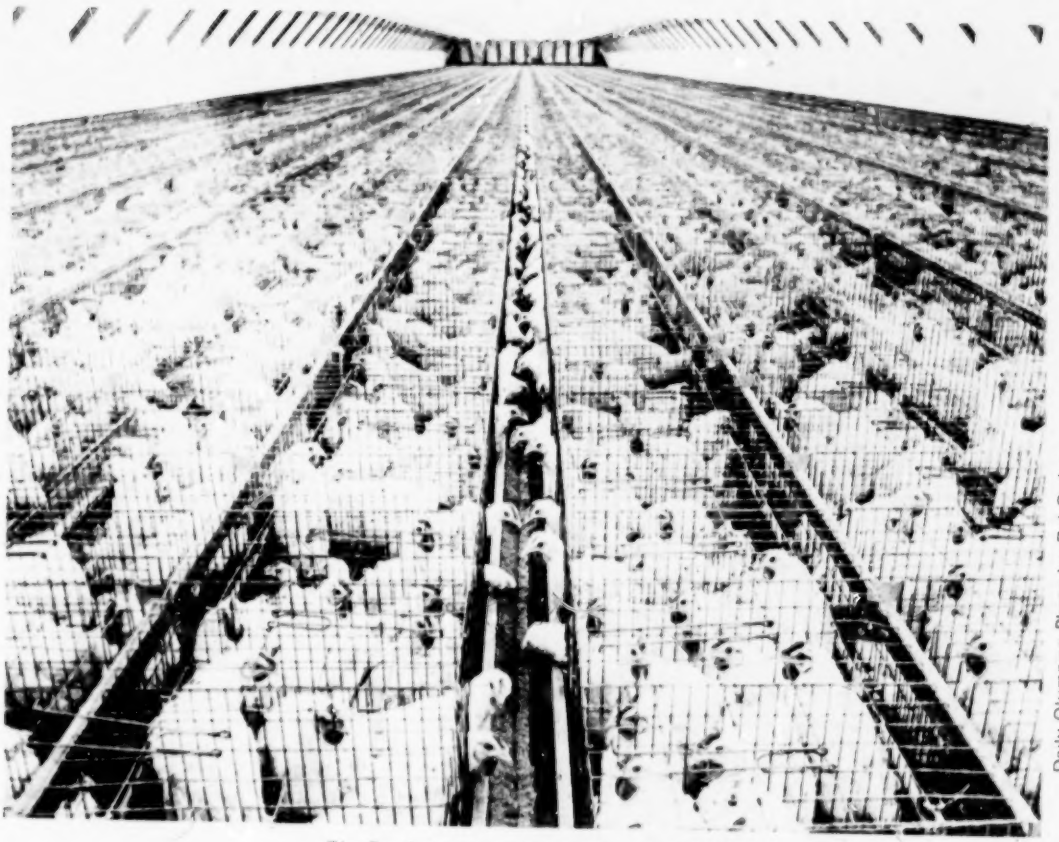
The problems involved in the disposal of animal waste have been brought about primarily by two factors. Following World War II, synthetic nitrogen fertilizers were made economical for farm use. Soon farmers were using fertilizer from a bag rather than going to the expense and trouble of hauling manure to the fields. Along with this, a shortage of labor increased the need for more efficient operations. This also increased the speed with which farmers adopted the practice of using commercial fertilizers.

Along with the drive for efficiency came larger and larger operations concentrating livestock and poultry in much smaller areas (fig. 2). These higher concentrations of animals obviously meant greater concentrations of animal wastes. The greater concentrations of waste soon became problems both in terms of engineering efficiency and esthetics.

Much of the change that needs to take place to solve our environmental problems is in the area of values and attitudes. Examples of wholesale exploitation of resources are almost endless. Among these was the appalling slaughter of buffaloes when only their hides were used. Another is the irresponsible strip mining that took place years ago and still contributes silt and acid to streams and leaves ugly scars on the landscape.

Even during times of such utter wastefulness there were those who stood out in the cause of conservation. There are many soil conservationists and soil scientists who could be listed for their contributions in protecting our natural resources. Many other persons in the USDA also had a part in protecting our natural resources. In forest conservation, the name of Gifford Pinchot stands out. In the early 1900s Pinchot launched a crusade for sound forest management and harvesting practices. He stressed watershed conservation, disease control, and fire protection. Much exploitation of our forest resources had already taken place, and it took a strong and dedicated man to begin to reverse this trend.

At this point, it might well be worth spending some time reading about some of the early leaders in our country who worked for better resource use and conservation. Reading about the frustration and dedication of many of these early leaders can be very inspiring and educational. It will also show us that other people have faced difficult environmental problems.



Daily Olympian Photo by Del Ogden

*Fig. 2.—A concentrated poultry operation.*

In analyzing any change, several factors must be taken into account. These include the attitude of people toward various problems, their appreciation for and interest in esthetics, their concern over the health hazards involved in the particular type of pollution, their willingness to accept restrictive regulations, and their willingness to pay the cost.

It is, after all, the public that generally pays the bill. When a public agency develops a program to improve the environment it is paid for by the taxpayer. If industry works on programs to improve the environment, it may be paid for directly by the taxpayer or be passed on in the form of higher production costs, which are paid for by the purchaser. If agriculture and forestry are to improve their practices to improve the environment, the increased cost of production will be paid for through governmental programs or increased costs in the products, which will eventually be paid by the consumer.

In talking about changes in the environment, it is likely that we still have to ask the following questions. How much improvement in the environment are we willing to pay for? What is economically feasible? What must we do to meet reasonable health standards? What does the general public believe to be socially desirable? We must also decide which things we would like to do, which we should do, which we must do, and which we can do.

In planning for change, we will have to make compromises in meeting various objectives. For example, it is easy to express concern over pesticide residues. None of us wants to suffer possible ill effects from accidental or inadvertent consumption of these

chemicals. However, it is easy to be just as concerned over biting into an apple and finding half a worm. In many such cases, it would seem logical that the answer will lie in a compromise of the extremes.

In planning for the future, it will be necessary to understand the long-term and broad-range concepts of the environment. It may well be necessary for economic and social goals to be at least partly controlled by legal means.

A better understanding of the stability of particular ecosystems and their dependence on diversity must be brought about. The more interdependencies in an ecosystem, the greater the chance that it will be able to compensate for changes imposed upon it. A complex tropical forest with its many interdependencies possesses much more stability than the limited plant and animal life found on the arctic tundra. Areas with limited interdependencies, such as the arctic tundra, are unstable, and changes often produce violent fluctuations in the populations of some species.

The least stable systems, those involving a single crop, are called monocultures. These are created by man in the form of cornfields or lawns that are soon overgrown with a wide variety of hardier plants constituting a more stable ecosystem if they are not carefully taken care of.

In planning for change, it is also necessary that we become more knowledgeable about the cycles upon which living systems depend. The oxygen cycle, which is crucial to survival, depends upon a vast variety of green plants. The hydrologic or water cycle is another cycle that needs still further study to determine how man is affecting it. The cycle by which nitrogen is taken from the air and made available to life on earth also needs further study. This cycle depends on a wide variety of organisms, including soil Bacteria and Fungi, which may be destroyed by pesticides in the soil.

Having looked at some of the problems that can be caused by change or are involved in change, let's take a more specific look at some of the kinds of problems.

## KINDS OF PROBLEMS

There are many kinds of environmental problems. The way that one person perceives and evaluates an environmental problem may be very different than the way another person perceives and evaluates the same problem. A person raising cattle and receiving an income from a large feedlot may perceive the problem of animal waste considerably differently than a person slightly downstream from the same feedlot who is receiving no income but deriving only what he sees as adverse effects. The value of leaving an area in its natural state or at least with a minimum of timber harvest may be perceived somewhat differently by a furniture manufacturer who is short of lumber and a person who enjoys hiking in the woods. The building of a dam for the production of power may be viewed differently by a manufacturer, who needs increased power to operate his plant, than by a fisherman who is worried about "supernitrification" disturbing his fishing after the dam is completed. The reaction to strip mining may be strongly related to our need for the resource being mined. The amount of filling and planting afterward may also affect our attitude (fig. 3).

*Fig. 3.—Strip mining in Washington State, as in many other parts of the U.S., has left ugly scars on the countryside. Some abandoned mines are being adapted to landfill use and recreation.*

## Pollution

Pollution is an often observable and sometimes dangerous sign of environmental deterioration. Pollution occurs when materials accumulate where they are not wanted. Natural processes cannot quickly adjust to the heavy load of materials, such as sewage or silt, which man or nature may add to them. Pollution often threatens natural systems, human health, and esthetics. Pollution is often a valuable resource out of place. DDT, for instance, is a valuable weapon in combating malaria, but DDT in lakes and streams can concentrate in fish and other wildlife and the smaller living things on which they depend.

In the past, the land, water, and air around man have absorbed his waste products. The ocean, the atmosphere, and even the earth were viewed as receptacles of infinite capacity. It has, however, now become apparent that man has exceeded nature's capacity to assimilate waste in some areas.

Most pollutants eventually decompose and diffuse throughout the environment. Organic materials are attacked by bacteria and decompose through oxidation. In other words, they rot. Some of our synthetic products resist natural decomposition. Plastics, some cans and bottles, and various persistent pesticides fall into this category. Even more alarming

is the fact that some of these materials are toxic, so they are serious dangers to health. For a detailed discussion of such materials, see the *Agricultural Chemicals and Radiation Unit*.

The next two paragraphs, taken from *Environmental Quality: The First Annual Report of the Council on Environmental Quality*, serve to show the importance of pesticide and radioactive pollutants.

> Some pollutants, which may be thinly spread throughout the environment, tend to reconcentrate in natural food chains. Pesticides tend to diffuse in ocean water. The physical effects of 1 pound of a well-mixed pesticide in 10 billion pounds of water may seem negligible, but many sea animals filter out particular kinds of chemical compounds, including pesticides, and collect them in certain parts of their bodies at concentrations far higher than in the water in which they live. Algae may concentrate some component of a pesticide which is then concentrated further in the fish that eat the algae. In turn, still further concentrations may occur in the birds that eat the fish. When the accumulation of the toxic substances reaches a high enough level, it may kill the organism directly or interfere with its reproduction. A well-known example of such accumulation occurred in 1957 at Clear Lake, California. DDD (similar to DDT) was diffused through the water in a concentration of only 0.02 part per million. The lake's plant and animal organisms, however, had stored residues of DDD at 5 parts per million—250 times greater than the concentration in the water itself. Fish, which consumed large quantities of these small organisms, accumulated DDD concentrations in their body tissues of over 2000 parts per million, and there was heavy mortality among grebes which fed on the fish.
>
> Radioactive fallout from the air also concentrates through food chains. Arctic lichens do not take in food through their roots but instead absorb their mineral nutrition from dust in the air. Radioactive fallout tends, therefore, to collect in the lichens and is further concentrated by grazing caribou, which eat huge quantities of lichen. Caribou meat is a major part of the Eskimo's diet. Although reconcentration of radioactive fallout at low levels has not been proved damaging to health, the effects of long-term, low-level exposure to radioactive pollutants are still not well known.

Although water pollution exists in all parts of the United States, it tends to be much worse where high pollution and industrialization combine. Therefore, water pollution problems are particularly severe in the Northeast and Great Lakes region.

Organic wastes dumped into our lakes and streams are broken down by organisms in the water. In the process, oxygen is taken up. Nutrients from cities, industries, and agriculture nourish algae, which also uses up oxygen when it dies and decomposes. As oxygen is taken from the water, the bacterial action in the water turns from aerobic to anaerobic, or from oxygen-demanding to non-oxygen-demanding action. When this happens, the river or lake dies, the game fish disappear, plant growth rots, and the water becomes vile looking and develops a terrible stench.

Some of the agricultural problems that contribute to water pollution include sediment, which is produced through erosion, particularly when the land is left unprotected. Plant nutrients are washed from agricultural areas from fields and feedlots where animal waste is produced. Animal waste also contributes to the organic material dumped into our lakes and streams. Water used for irrigation is returned with a higher concentration of inorganic salts and minerals. Organic wastes are produced by agricultural concerns in the processing of fruits and vegetables. Byproducts from feed and fiber processing plants as well as from forest industries produce large quantities of organic waste. Plant residues are another source of organic waste from agriculture.

Air pollution is not a new problem. Laws were passed in the last century to help prevent air pollution in some of the world's major cities. Most of these earlier cases of air pollution were, however, basically temporary problems. It was not until well into this century that the problems in Los Angeles became daily phenomena. Now smog and air pollution have become problems in every major city and in many smaller towns and villages. The problem is an extremely hard one to deal with since the largest single contributor is that of transportation vehicles operated by such a multitude of individuals.

Agriculture is also a contributor to air pollution. In the United States each year an equivalent of 30,000 acres of topsoil is allowed to enter the air. Agriculture is not the only contributor to this dust problem but is a major contributor of airborne soil. Soil is allowed to blow away when pastures are overgrazed (fig. 4). Dust from hay and silage and feedlots is also a problem along with dust from harvesting. Another problem is the smoke and ash coming from the burning of forest and plant residues. Burning of plant residues also spews a

USDA Photo

*Fig. 4.—An overgrazed range contributes to the dust problem.*

certain amount of chemicals into the air. Pesticides being applied to crops or animals may drift through the air for many miles. Airborne soil may also carry chemicals.

An area that has received very little attention is noise pollution. One problem with noise pollution is that so much noise can be produced with so little energy. Thus, there is little economic saving in preventing noise as compared with preventing air pollution where the materials recovered may have economic value. The noise involved in many types of occupations in the United States has been shown to produce hearing losses over a period of time. Farmers are among those who have been shown to be suffering hearing losses. Hearing losses among working males in the United States have become so widespread that it has been reported to be hard to establish what normal hearing is. One of the problems with our advancing technology has been that noise seems to have advanced right along with it. Many of the factors involved in measuring noise are somewhat complicated and, at least on first glance, they do not seem to be as pressing as some of the problems in other areas. It is probably for this reason that, until recently, noise has received little attention as compared to many other types of pollution.

## Land Use

Land use is one of the most important policy decisions made in any country and affects nearly all the people. Many land-use directive and control measures are applied in the United States. Since special districts or small units of government may make land-use policy, methods of carrying out those policies may differ from area to area. Because of the large numbers of people involved in many situations that occur in land use, policy decisions are difficult to make and slow in coming.

The population in America has had two major shifting patterns in the 20th century. First, people from farms have moved to cities, then, people from cities moved to the suburbs. Land misuse is one of today's most severe environmental problems. Because of the shifting population and other characteristics, urban areas have changed rapidly. Old buildings and neighborhoods are razed and replaced by structures designed with little or no eye for their fitness to a community's needs. Suburban developments sprawl helter-skelter over the landscape. The inner city is often found decaying and left for the poor since they cannot afford to get out. Many battles have been fought against inner-city decay; few have been won.

In an effort to get further away from urban areas, people have continually moved the suburban ring farther and farther from the inner city. In many areas, the land taken up by these new housing developments and the accompanying shopping centers and other facilities has been good agricultural land. Once this land is covered with growth, buildings, and other concrete structures it is likely lost for agricultural purposes forever. A livestock producer may be forced to move his operation because the odors and other characteristics of his operation are deemed by the courts to be incompatible with the people that live around him. He may move to a new location only to discover that people are once again building new houses ever closer to his operation. There is little question that, in many of these situations, better zoning laws need to be instituted to protect the producer and the public.

Some other problems include the fact that real estate developments are sometimes built on flood plains or carved out along unstable slopes. Many times lives and property are endangered because of such poor planning.

There is much concern that wilderness and park areas may be substantially destroyed by the continued large numbers of people visiting them (fig. 5). Some of our national parks have such concentrations of automobiles going through them during the busy summer period that automobile emissions reach levels similar to many of our urban areas. If this trend of increasing use of national parks and wilderness areas continues, they will become crowded gathering places with lessened value to all visitors. While a large percentage of wilderness and other areas are unused, the people flock to well-known areas such as Yellowstone and Yosemite National Parks. The worldwide increase in tourism, combined with rapid and cheap transportation and increased free time, is threatening the very values upon which tourist attraction is based.

The jetport planned for west of Miami and north of the Everglades is one example of a land-use problem. The jetport, its associated transportation corridors, and the likely increase in residential, commercial, and industrial developments would certainly have imperiled the unique ecological preserve found in the Everglades. Much planning went into the proposed jetport to determine the density of population, regional transportation needs, and many other variables. However, little consideration was given to the wildlife and recreational resources of the Everglades. There is little doubt that such a project would have diminished water quality and drastically altered the natural water cycle of southern Florida. Such changes in the environment would, in turn, have endangered all aquatic species and wildlife within the Everglades and beyond.

Weyerhaeuser Photo

*Fig. 5.—Crowding at parks, forests, and recreation areas keeps increasing.*

### Natural Resources

Natural resource depletion is an important environmental concern. It is particularly important to a society such as our own, which is highly technological and demands great quantities of natural resources for energy, building materials, and recreation. The problems caused by the exploitation of resources may result in greater expenditures to repair the damage than the original value of the resources themselves.

A case that illustrates this point was the Federal Government's decision to permit oil drilling in California's Santa Barbara channel. The decision in this case was based primarily on development of the oil resources. Commercial (as a port), recreational, esthetic, and ecological values were largely ignored. It is in this area that the blowout erupted in January 1969, spreading a coat of oil across hundreds of square miles, including a State sanctuary for wildlife.

Development and use of natural resources is going to require greater planning across our country in the future. It will be important that such planning include considerations of recreational, esthetic, and ecological values. We shall have to more carefully weigh the uses of our natural resources and develop more efficient means of utilizing them.

## CAUSES OF PROBLEMS

Causes of many of our environmental problems are complex. Many of them have become an integral part of our society and economic way of life. We have often emphasized growth and expansion with little concern about improving quality. Our economy has often most favored those who most ruthlessly consumed our natural resources and paid least attention to the problems they were creating in the way of pollution. We have spent little time in planning, decisionmaking, and considering the effects on the environment of the things we are proposing. As a society we have continually demanded more and more with little realization of the drain on our resources. Most of us have had, at best, a very narrow view of the environment and the complex interrelationships of the various parts of the environment.

### Population

Many Americans have just begun to realize the importance of population and its distribution on the environment. For many years, our country acquired land and continued to move to the West. This expansion was basically stopped when the frontier ended at the Pacific Ocean many years ago. Since the area of the country has remained constant while the population has continued to increase, it is easy to see why the population density or number of people per square mile has increased.

#### Control

The population of the United States in 1970 was approximately 204 million. This is twice the population of 1920. If the present rate of growth continues, we will reach 300 million around the year 2008.

Considerably adding to the problem is the fact that there are so many persons now in the child-bearing age range. Because of this problem, it seems nearly impossible to expect anything but increasing population over the next several years. The Commission on Population Growth and the American Future reports that "Even if immigration from abroad ceased and families had only two children on the average just enough to replace themselves our population would continue to grow until the year 2037, when it would be a third larger than it is now." The Commission, in commenting on the difficulties in achieving the zero population growth at the present time, says that "Our past rapid growth has given us so many young couples that they would have to limit their child bearing to an average of only about one child to produce the number of births consistent with immediate zero growth. Ten years from now the population under 10 years old would be only 43% of what it now is, with disruptive effects on the school system and ultimately on the number of persons entering the labor force. Thereafter, a constant total population could be maintained only if this small generation in turn had two children and their grandchildren had three children on the average. And then the process would again have to reverse, so that the overall effect for many years would be that of an accordion-like mechanism requiring continuous expansion and contraction."

The importance of limiting the size of families can readily be seen in figure 6, which also shows the effects of a three-child family versus a two-child family.

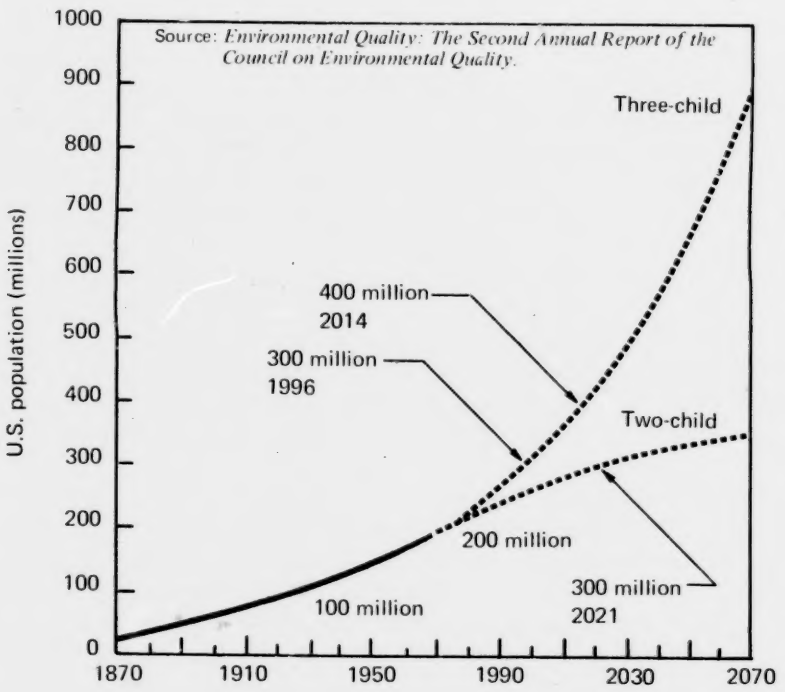



*Fig. 6.—Projected U.S. population: effects of three-child and two-child families.*

Although keeping population at its present levels does not seem possible, more and more people are becoming concerned with at least slowing down the growth rate.

Increasing population growth will certainly have a depleting effect on the nation's natural resources. At the present time, the United States has about 6% of the world's population but uses more than 40% of the world's scarce or nonreplaceable resources and a similar percentage of the world's energy output. Assuming that the world has a nearly fixed amount of natural resources, continued population growth will require reductions in the amount of resources that each person can use.

There is still some question among authorities as to what the optimum population should be. Some feel that we have already passed the optimum level while others believe that it has not yet been reached. Controlling population becomes extremely troublesome because it strikes at deeply held religious values and at the preference of some Americans for large families.

## Mobility

The growing mobility of the American people in itself is a threat to the environment. The physical movement of people has caused problems in both metropolitan areas and recreation areas, parks, and wild areas. The population outside metropolitan areas is not high because Americans seem to have almost a compulsion to live in urban areas. This has been particularly true in the coastal and Great Lakes regions. If this trend continues to the end of the century, 70% to 80% of all Americans will be concentrated in five large urban complexes. Many of the present problems facing the nation, such as water, air, and noise pollution and inefficient land use, will increase as population densities increase in these areas.

Improved transportation, such as the automobile and aircraft, have increased mobility. This has allowed people to live greater and greater distances from their places of employment which, in turn, has increased the urban and suburban sprawl. These improved forms of transportation have, however, generated noise, air pollution, and necessitated increased construction of highways and airports, all of which have affected the environment.

As improved transportation has allowed Americans to move further from central cities, thousands of acres of undeveloped land have been developed each year. Automobiles, in particular, have allowed families to occupy single-family homes, which have encroached further and further on open spaces. Many of these developments are drab in design and wasteful of land. Many of these developments have removed trees thereby affecting the climate. The developments often cause erosion, muddy rivers, and increase the cost of public services.

The mobility of the American people has had particularly far-reaching effects on such States as California. Even while some States have endured extreme hardships because of the rapid increase in population, others have had actual losses in population. Such fluctuations in population have often adversely affected both the rapidly increasing area and those that lost population. When population is increasing at such a rapid rate as it has been in California, it is obvious that it is very difficult to plan for governmental services, schools, or anything else.

## Values

Americans have placed a high value on convenience in consumer goods in recent years. They have come to enjoy, if not demand, the convenience and comfort of modern housing, transportation, communication, and recreation. A higher priority has been given to convenience and comfort than to having clean air, good quality water, properly cared for waste, and less noise pollution. Many people who have demanded such goods and services have had little understanding of the effects such demands are having on noise levels and in choking off open space, forest, clean air, and quality water. It is only recently that some of us have begun to realize the connection and conflicts between convenience and a deteriorating environment.

Some of the values that cause problems today were likely shaped by past extravagance. As our country expanded westward there was little environmental concern. After all, there appeared to be little reason for concern when it seemed we were almost surrounded by inexhaustible forests, minerals, rivers, lakes, fish, and wildlife. Today, some of these resources have not only been shown to be exhaustible but are scarce, particularly in high-population areas. Such a realization makes us aware of the need for changing values and more conscious of the choices we must make based on values. To some extent, values can be gaged by how much we as a Nation are willing to spend to protect them.

To some extent, individuals will have to control pollution through changes in their actions. (That much improvement is needed in our actions is evident in looking at figure 7.)

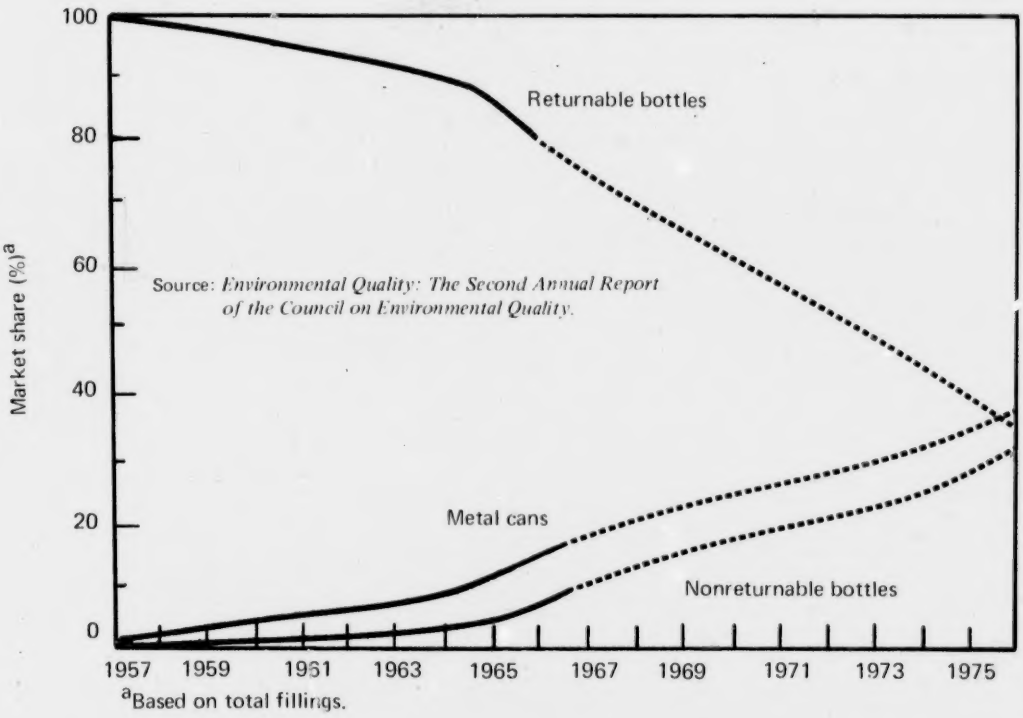



*Fig. 7.—Soft-drink containers by type, 1957-76*

This is particularly true when they are purchasing consumable goods. The changes in composition of paper shown in figure 8 will have effects on the environment. Until we are willing to learn the difference between biodegradable and recycled paper, how do we know which one to use? Biodegradable means only that the material will break down or rot. Recycled indicates that the fibers have been reused. This has two advantages in that it reduces the solid waste by the amount of fiber used plus it saves trees by not using more wood pulp.

Some of the programs needed to improve our environment can be paid for with tax money and be taken care of through Government programs. Tax money and Government programs will not, however, take care of the entire problem. Ultimately, we as individuals will have to forego some of our conveniences and will likely have to pay higher prices for some goods and services. The extent to which this is necessary will depend partly on increases in our population.

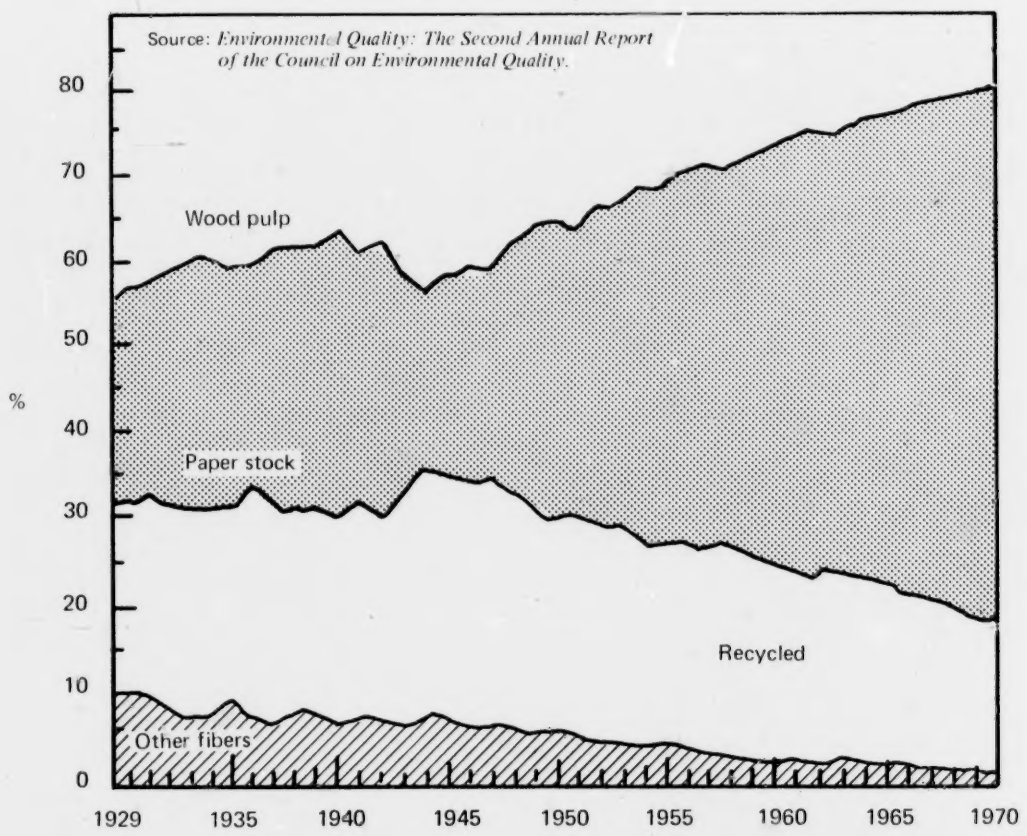


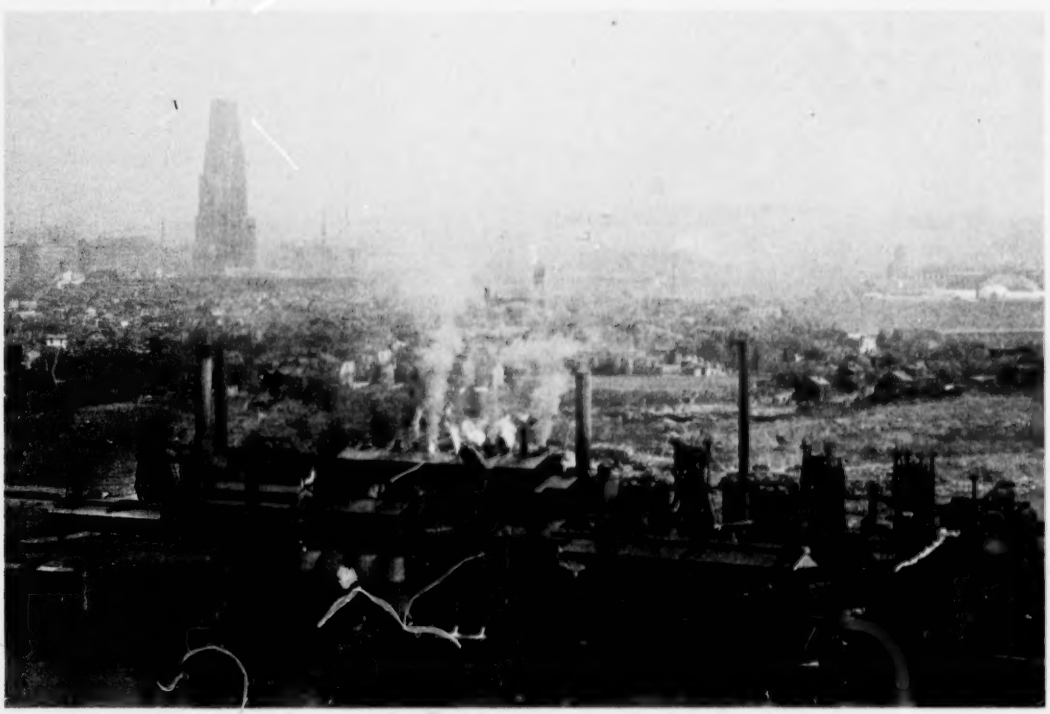

*Fig. 8.—Trends in composition of paper.*

## Technology

The major environmental problems we are facing today began to become important problems with the Industrial Revolution. Great quantities of smoke and raw industrial waste were seen spewing forth from factories across the country. It is interesting how easily we ignored what we saw and simply thought of it as part of the process of production. At times we pointed quite directly at the pollution we were causing and probably said, "Look at the progress we are making."

Today, environmental problems have reached such a severe state that they can no longer be ignored. Even in recent years, the economy has grown more rapidly than our efforts to deal with the unwanted byproducts we have produced.

Our rapidly growing economy has had other effects on the environment besides just increasing the total amount of waste produced. Because of the rapidly growing economy, we have accelerated our pace of technological innovation. Some of these technological innovations have helped us to provide solutions to environmental problems. At the same time, new technological innovations have increased our environmental problems in other areas. We have developed new chemicals, new uses for metals, and new industrial processes, each of which can be hazardous to man and his surroundings. The pace of these technological innovations has been so rapid that our scientific knowledge and regulatory abilities have not been able to control some of the injurious side effects that occur from the use of these technologies. There is little doubt that, for some time to come, numerous problems will be caused by our increasing technology. In the future, we must more carefully try to understand the direct and indirect effects of technological innovations before they are put into practice (fig. 9).



USDA Photo

*Fig. 9.—Technology has sometimes brought more than progress.*

Increased technology has raised our standard of living so that we may use more goods and services; this, in turn, adds to environmental problems. Because of increased technology, the working week has been shortened, allowing more leisure time and longer vacations. Increased leisure time increases the demand for goods used for recreation and increases the number of people using parks, forests, and recreation and wilderness areas.

### Misdirected Economic Incentives

It is easy to point an accusing finger at business and industry. Much of the blame, however, should be placed on the misdirected incentives in our economic system. To make progress in improving our environmental problems, we will need a clearer understanding of how our economic system works, how it affects the environment, and what alternatives are available in improving environmental quality.

Our present economic system often fails to take into account the environmental damage done by a polluter and the effects that this has on others. Economists call these damages external social costs. What happens with these external social costs is that one individual or company is able to use water or air as a free resource and even for waste disposal while others pay the cost and/or suffer the consequences of the pollution. A company may produce its products cheaper by not properly treating its sewage. A person living further downstream may suffer from odors or other effects from the stream. If we can develop a way of establishing prices for these external costs, then the next step would be to try to charge the firm the cost established. This could possibly be done by taxing on the basis of the amount of discharges from a plant. The prices for the goods and services produced would have to reflect these costs in order for the company to continue making a profit. Since we are not presently doing much to charge companies for their external social costs, the products and services they produce are underpriced. If companies were required to pay on the basis of pollution produced, prices of some products and services would increase substantially. Increasing the price of such products and services would likely lower their demand and would, to some extent, discourage the buying of pollution-producing products.

Some of our taxes also result in misdirected incentives. For example, the property tax may encourage the building of poorer quality housing. Such poor quality housing may not only detract from the esthetics of the environment, but also require the use of more resources in the long run to replace such housing. Poor land use may result because it is more favorable for a community to encourage industrial development than high-density housing. This may be true because industry will pay more tax and/or the high-density housing will require more public services. Other taxes encourage land speculation and the rapidly spreading development that has become the trademark of the urban-rural fringe.

### Limitations of Government, Laws, and Enforcement

Many governmental agencies now working on solving environmental problems were not originally designed to deal with the important problems they now face. They often cover too small an area geographically and have only limited powers within the small geographical area. For example, agencies dealing with water pollution usually do not cover the geographic problem area of an entire watershed. Even when a governmental agency has control over an

entire watershed, it will still likely not have control over sewage districts, municipalities, irrigation districts, and a multitude of other local institutions. An effective attack on water pollution may require the establishment of new governmental agencies covering larger geographical areas and with power to construct, operate, and finance the necessary facilities.

Public decisions, like private decisions, often favor a short-run economic choice instead of long-term environmental protection. There is tremendous pressure on local government to develop land and increase jobs and expand the tax base. This is true even when the land being developed may be valuable open space or irreplaceable marshlands. The problem has become even more difficult because of the large number of agencies that control various and often narrow districts. These agencies often operate with little consideration of broad goals. When it becomes each local government for itself, the problems are somewhat obvious. New industry and development that produces economic benefits for one town may create pollution and loss of recreation for a town further downstream.

One of the problems with pollution is that many people do not realize they are causing it. Many activities continue because of incomplete or wrong information about their impact on the environment. Many times the changes made to the environment are so slow that they are difficult to detect. An accumulation of these slow and difficult to detect changes may cause irreversible harm to the environment. Widespread use of certain types of pesticides and other dangerous substances occurred without advance recognition of their potential for harm.

Many laws have now been passed to protect and improve the environment. Some of these laws have been worded in such a way as to make it virtually impossible to enforce the intent of the law. Even when good laws have been passed, enforcing them becomes a tremendous job. Just monitoring to see what is happening and to check for possible violations requires a large manpower force. Some people feel that we can do better with a charge system that sets a price on discharges that a factory puts out. They feel this would be more effective and easier to operate than the traditionally cumbersome enforcement process. The Council on Environmental Quality, in its 1971 report, urges stricter and more systematic enforcement of air and water standards. They realize, however, that this cannot be done without better monitoring and data. They also emphasize the necessity of clear-cut enforcement policies that will better inform poeple of what is expected and what will be required.

The Council on Environmental Quality also believes that economic incentives offer promise, especially if they can be backed up by regulatory power. They would like to see such a program selectively demonstrated, and they believe that effluent or emission charges should be evaluated as a supplementary method of stimulating abatement measures.

At present, many agencies are relying primarily on voluntary compliance with their programs. This is more economical and requires fewer people to police the program. The manpower available can be used to carry out enforcement proceedings against violators. Because of a lack of manpower and funds in most agencies working on environmental improvement, many programs will have to be basically voluntary for the foreseeable future. This is true because there are not enough people to enforce the policies.

## EFFECTS OF PROBLEMS

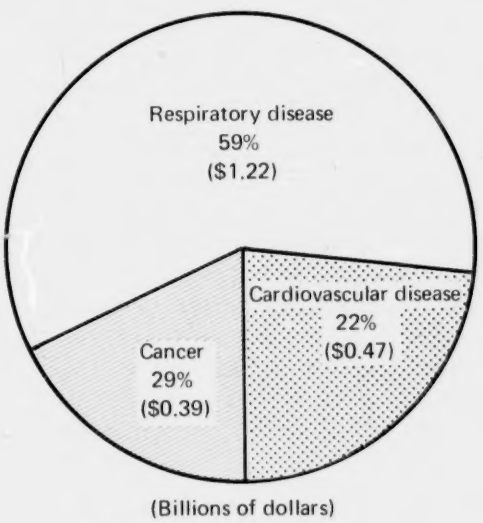
The effects of environmental deterioration are sometimes subtle and often slow in becoming apparent. The speed of change in our rapidly altering technological society makes evaluation of the status of the environment difficult. Long-term effects of such rapid changes are even more difficult to assess. The values a person holds may greatly influence his views of which are the most serious problems involving the environment.

### Health

Many of the environmental problems that affect human health are very complex, making environmental changes and their effect on well-being very difficult to evaluate. There is, however, ever-mounting evidence showing that today's environment has a large and adverse impact on the physical and emotional health of an increasing number of Americans.

Air pollution and its effects have been closely studied over the past 10 years. The relationship between air pollution and such chronic illnesses as emphysema and chronic bronchitis is becoming more evident. These two diseases are major causes of chronic disability, lost work days, and mortality in industrial nations.

It is often difficult to attribute death to particular causes such as bronchitis and emphysema. However, physicians in the United States attributed 18,000 more deaths to these two causes in 1966 than 10 years earlier. This is an increase of two and a half times. Increases of materials such as sulfur oxides, photochemical oxidants, and carbon monoxide in the air have been shown to be related to hospital admission rates and length of stay for respiratory and circulatory cases (fig. 10).




Source: *Environmental Quality: The Second Annual Report of the Council on Environmental Quality.*

*Fig. 10.—Health costs of air pollution.*

It has been known for a long time that many types of diseases have been spread by contaminated water. Some streams in the United States have become so polluted that they are a health hazard just to be near. At the same time that such problems with pollution have been occurring, better treatment methods have also been developed, and very putrid water can be treated so it can even be used for drinking.

A health hazard that has not received as wide research or public attention is noise pollution. One of the effects of noise is to cause either temporary or permanent hearing losses.

There are great individual differences in people's abilities to cope with noise. Some persons are able to take a great deal of noise with little bother while others are extremely sensitive. The sensitivity to noise may vary considerably from day to day in the same individual.

Noise has been shown to produce various kinds of temporary changes in man's physiological state. One of these changes is a constriction of the smaller arteries. This in turn may increase pulse and respiration rates. Some medical authorities believe that long-term exposure to loud noises can cause chronic effects. Such effects can include hypertension and ulcers. Exposure to noise is certainly bothersome when one is trying to sleep, but it may also affect a person's ability to sleep sometime later. A noise associated by a person with some fear may cause particularly intense emotional reactions.

Whether low-level accumulations of radioactive fallout in body tissues will eventually produce casualties cannot now be predicted. More research needs to be done on this to determine long-term effects of radiation.

The greater incidence of major malignancies of the digestive, respiratory, and urinary tracts in the urban environment also needs to be investigated. The frequency of these diseases is much higher in urban than in rural environments.

## Ecosystems

Ecology is the science of the intricate web of relationships between living organisms and their living and nonliving surroundings. These interdependent living and nonliving parts make up ecosystems. Many of these ecosystems may be severely damaged by changes brought about by man. For example, the great dust bowl of the 1930s was largely a result of the misuse of land resources. Also, many estuarine areas have been altered and their ecology permanently changed because of structures built by man.

Looking at the whole world, some scientists feel that air pollution could trigger large-scale climatic changes. Many other man-made changes may also be changing the environment very seriously. Removing trees may have great effect on both air and water. Construction covering large areas with asphalt and concrete will change the ability of soils to absorb water. The spilling of oil on ocean waters has the short-term effects of damaging the esthetics of the area and often killing at least part of the wildlife. The long-term effects of such oil spills are still being studied.

## Economic Costs

The economic costs of pollution are gigantic. Pollution costs billions of dollars annually. Some of the cost of pollution includes the faster deterioration of paint. Increased

cleaning bills and air filtering systems are necessary as well. City dwellers have increased costs in household maintenance, cleaning, and medical bills. A farmer's crop may be reduced in quantity or quality or be destroyed. Water pollution may prevent or increase the cost of swimming, boating, fishing, and other recreational and commercial activities. Treating water before or after it is used for many industrial purposes may considerably increase the cost of the products produced. Also, there is the cost of the resources wasted as they are belched out of smoke stacks or dumped as treated or raw sewage from industrial plants.

The cost of noise pollution may be harder to pinpoint. There is evidence to show that exposure to noise increases medical costs. Other studies have shown a decrease of efficiency as workers were exposed to noise. This is another economic cost.

## Esthetics and Recreation

Man through history has enjoyed the esthetics found in nature. Being near a beautiful lake or river, walking into the mountains or through a forest, or just observing wildlife has often filled man with a sense of joy. The importance of the deterioration of the environment and its effects on man's attitudes and aspirations cannot be measured. Many people today are seeking a better environment in which to live and work. Others at least want to escape temporarily by visiting a national park, recreation area, or forest (fig. 11).

USDA Photo

*Fig. 11.—Considerable planning has gone into making attractive signs and facilities for National Forests.*

Many persons prefer leaving the urban areas where crowding, noise, fumes, and foul water are all present simultaneously to try to find more esthetically pleasing surroundings. However, in their desire to leave their objectionable surroundings and move to more pleasing surroundings, they spread to ever greater areas many of the problems they are trying to avoid.

Americans are becoming less and less willing to endure offensive sights, odors, and sounds. Let us hope that these objections will help in stopping further deterioration of our environment and will help to improve it.

As with esthetics, it is extremely difficult to establish the cost or value of recreation. Because of the importance of having some kind of figures on which to base decisions, economists have been working on many different ways of obtaining meaningful figures. One method used is benefit-cost analysis. In recreation, this involves determining, basically, the amount that people are willing to pay for particular types of recreation or for the use of parks and other areas. Such a method of analysis tends to favor the wealthy since they are able and often willing to pay more for what they want. Thus, decisions on recreation made solely on such an analysis will almost always be more favorable to the rich than to the poor. Even though we have not been able to determine exact values of recreation, it is easy to agree that there are many values and also that pollution is destroying some of the recreational possibilities.

In some of the major cities, school physical education and recreation programs have to be cancelled when smog reaches certain levels. Vigorous physical activity during these high smog concentrations has caused people to cough, to show other respiratory problems, and even to require medical attention. Lakes and streams, particularly near many of our larger population centers, have become so polluted as to become almost entirely unusable for any type of recreation. In many of these streams, there is little or no wildlife or fish left. The water is much too polluted to swim in and in some cases is not even recommended for boating since a person accidentally falling overboard into the polluted water could be exposed to considerable hazard.

Areas that have been used for recreation and are well away from high population are often damaged by increased development in the area. This has been a particular problem near many national parks where developments have often grown rapidly, particularly those serving tourists.

Increased numbers of visitors at our national parks have caused several kinds of environmental problems. The mere crowding of people in some of these parks have made them much less desirable to visit. The automobiles that come in ever greater numbers pollute the air and may leave a haze of smog over much of the park area. The increased number of people means greater amounts of waste, which may seriously jeopardize the purity of streams and cause serious problems in the disposal of solid waste. When beaches or fishing areas become too crowded, much of the enjoyment once experienced may disappear (fig. 12).

Nutrients being dumped into water may change the aquatic growth. The resulting increases in water weed growth in lakes may become a great nuisance in the operation of a motorboat.

Certain industries, such as the forest industry, may operate on or near public lands in such a fashion as to make the land less desirable for recreation. At the same time, some of these industries have properties that they are using for production of forest products and, through good multiple use practices, also allow the public to use the area for recreational purposes.

Weyerhaeuser Photo

*Fig. 12.–Many beaches are becoming more crowded.*

## PROBLEM SOLVING

Many of the problems that we are facing in the environment have developed over a long period of time, and it is probably not realistic to expect that they will be solved quickly. However, improvements can be made and some of the improvements can be made very quickly. In recent years there have been some changes of attitudes among private citizens and groups. Some of these attitudes have been passed along to governmental leaders, and the concerns are showing up in the form of new laws, new agencies, and new Government programs. Although progress has been made, further changes in values and attitudes will be necessary for continuing improvement in the environment. The responsibility for changing many of these values and attitudes will be left to our educational system. Improving environmental education programs will be necessary for years to come. Many of the environmental problems are of such scope as to require, not only action by groups and our Government, but also cooperation between governments and between nations. International cooperation will be necessary to improve the atmosphere and oceans of the world.

### Citizen Participation

The growing concern about the deterioration of the environment can probably best be seen by the increased awareness and action of citizens and citizen groups. Citizen participation is taking place on an individual basis, in civic and conservation groups and in many other organizations, and through the action of entire communities (fig. 13). The concern of these groups is often much broader than their own local issues. It reaches to regional, national, and international environmental problems. The concern may embrace

*Fig. 13.—The Soil Conservation Service can provide professional assistance on land terracing to prevent soil erosion and water run-off.*

such broad and diverse areas as air, water, and noise pollution; solid waste problems; land-use problems; and a host of problems associated with plant and animal life. The focal point of many of these groups is the local area or community. Citizen groups have played an important part in improving the environment.

Many forms of environmental deterioration have been present all around us. Parks have been destroyed or divided by highways and other construction development. Marshes have been drained and, along with other recreational and wildlife areas, paved for industrial and residential development. Marshes have also been drained for agricultural use. We have run streams underground and cut down trees in the name of progress. Many of us, while seeing what was happening and regretting the destruction of the environment that was taking place, accepted it as a necessary price to be paid for progress. Now we have begun to ask if this is really progress or if it is really desirable and are looking for alternatives in trying to assess whether the deterioration of our environment is worth such "progress."

Citizen interest in protecting and improving the environment is not new. Many of the groups that were interested in the environment in the past, however, had a much narrower emphasis. Such groups included fishermen, hunters, farmers, conservationists, naturalists, and professional outdoorsmen. These groups, along with some scientists, were the first to really work for environmental causes. These early conservationists developed the concept of wildlife sanctuaries. They had a vital part in shaping legislation to require hunting and fishing licenses, the revenue of which has gone to improve wildlife protection. Early conservationists fought against great odds. Many farmers spent their money on conservation practices that, in many cases, did not repay them economically. Other persons throughout history have spent a great amount of money and time and have even felt great social and political pressures because of their stand in protecting scenic and wilderness areas. If it were not for these great efforts, we would likely find areas like Yellowstone National Park, the Grand Canyon, and the Olympic Peninsula permanently damaged.

Today's environmentally concerned citizen is somewhat different than many of the conservationists of the past. They often speak differently than the long-time professional conservationists, although the two are often allies. Many of the new environmentalists are from urban areas but have developed a keen awareness of nature. Many of these environmentalists are young and very concerned with urban environmental problems. Some of these environmentalists have chosen more direct, active ways to express their views than the traditional conservationists.

Citizen groups are organized at the local level across the country. Such groups have worked to pass ordinances and to actively carry out environmental improvement programs in every State. Urban areas have received special new thrusts due to the work of such groups. In the New York metropolitan area alone over 200 organizations are working on environmental problems. The activities of such groups cover nearly every area of environmental protection and improvement.

Many of these organizations have State or regional headquarters to help coordinate and improve the resources that the local organization has available. Further, many of these organizations have formed conservation councils, which are organizations of organizations. The council often serves as a common meeting ground for the various members. It also serves as a clearing house of information about action at the State level. The main emphasis of the council may be education and the dissemination of information to members and the general public. On the other hand, the main emphasis of the council might be legislative and political action.

Many environmental councils rely heavily on services contributed by member organizations and volunteers. Some councils have academic and technical consultants. Some councils are formed on a geographic basis to cover a particular river basin or other area of environmental concern, thus, all the members have common climatic, economic, cultural, and historic characteristics.

There are many national organizations with large memberships that exist to inform, guide, or represent their members in a wide variety of environmental and conservation matters. Some of the prominent organizations include the National Wildlife Federation, National Audubon Society, Isaak Walton League of America, National Recreation and Park Association, Sierra Club, National Parks Association, and the Wilderness Society. There are many other organizations consisting mostly of professionals in recreation and conservation fields. Other large national organizations, with prior interests but having environmental interests as well, include the League of Women Voters, the National Association of Counties, the Garden Club of America, the United Auto Workers, and the AFL-CIO. These organizations all carry on substantial national environmental programs. Newer organizations such as Friends of the Earth and Zero Population Growth seek direct, active involvement in environmental controversies. Many of these organizations have grown very rapidly over the past 3 or 4 years, as they have become more active in environmental concerns at the same time that many people were looking for organizations that could represent them in this area.

### Environmental Education

Educators were as slow as most other people when the public began to become aware of worsening environmental problems. Many educators were as unaware and negligent in environmental matters as the general public. It was therefore a tremendous challenge for the educational system of this country to broaden to include environmental education.

There is not a good and generally accepted definition of environmental education. Many of the things that should be covered in environmental education can, however, be generally agreed upon. For example, students should understand how the natural world works, not only its parts, but also the interrelationship of each of these parts one through another. A student should see history, not only as a series of acts, dates, battles, and names, but also as the fabric of our past in relationship to our present. Environment should likewise be seen as a web of relationships.

Most educators now seem to agree that ecology does not need to become a course like history, algebra, or biology but rather should become a part of many courses spread throughout a student's education. Because such needs were apparent, units such as this one were developed for use in various parts of a student's educational program. It is abundantly clear that man does not know enough about the environment around him and what affect he is having upon it. Some fairly harmless activities have been shown to move in sometimes dangerous ways upon the environment. Therefore, environmental education is a key to keeping this a livable world.

As well as knowing how the natural world works and how man is affecting it, many other factors need to be studied. Students should have a better understanding of our economic systems and political institutions and the influence that these have on the choices that we make. The choices that we make often set off chain reactions within our environment. Many of these choices will be changed only when we are willing to change our personal values so as to be willing to pay the price of controlling pollution.

Environmental education is more than conservation education. It has to cover more than the concerns about pollution. We need persons who are environmentally educated so that they understand that they are a part of a system composed of people, culture, and physical and natural surroundings. We must know and appreciate that man's acts can change this system and his relationships to the system. We must appreciate the human ability to control, preserve, and destroy the environment to some degree. We must be willing to accept responsibility for the condition of our environment, even if we do not know what to do about it.

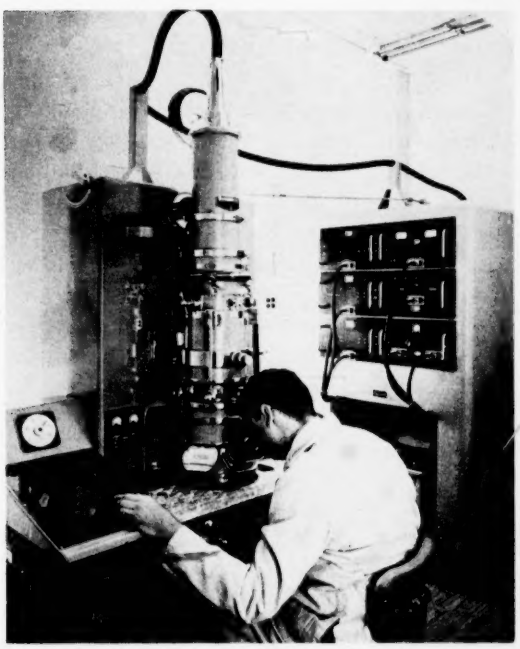
A scientific study of the earth's life support system is not enough. We must also learn to understand how economic and political factors, social pressures, and cultural values affect environmental decisions. Environmental education must be relevant to people wherever they are, whether it is in cities, urban areas, or rural areas. A student should become more aware and knowledgeable about his environment but should also learn to understand what his environment could be.

New programs with many innovative ideas are being adopted from preschool through colleges and graduate schools. Many of the national environmental organizations as well as educational institutions have worked on programs that should improve environmental education at all levels.

Because of the new emphasis on the environment, some jobs requiring specific skills are becoming available. In an effort to improve the environment, billions of dollars will be spent on research, education, and control. Many of the facilities where work is now being done to improve the environment have manpower shortages in the technical and professional areas. This will mean that there will be areas of high demand for those with the proper post-high-school and college training who can work on problems of water supply, waste water treatment, solid waste management, air pollution control, and noise pollution control (fig. 14).

There will also continue to be a need for persons trained in such traditional areas as plant and soil science, forestry, animal science, and many of the other traditional areas of agriculture but who have a knowledge and understanding of the environment and at least a minimum of skills that will contribute to improving the environment.

There is also a need for more educational activities outside the formalized school system. Many educational activities could be carried out by or within various citizen groups. Field days could be held and various kinds of demonstrations could be presented. Television specials on the environment have covered many problems. Magazines and books have also done much in the way of discussing environmental quality. In the end, however, each of us as individuals must assess how we are affecting the environment.



USDA Photo

*Fig. 14.—A career in environmental monitoring can be very interesting and challenging.*

**Governmental Programs**

Governmental programs at all levels have been greatly accelerated with the emphasis on environmental quality. The Government at most levels has not been organized to vigorously pursue and attack environmental concerns. Many separate agencies at the Federal level and separate departments and groups even at the local level have been involved in various programs that have involved the environment. Such organizations have often allowed for an overlapping of functions and some inefficiency. An even greater problem may have been the fact that no single agency or department was in charge of coordinating a comprehensive environmental effort.

At the Federal level, the Environmental Protection Agency, the Council on Environmental Quality, the National Oceanic and Atmospheric Administration, and other organizations and agencies within the Government now have much broader powers in the development of environmental policy and the analysis of environmental trends and programs.

Many of the agencies that have had a concern for the environment have had other primary concerns. The primary concerns often left little time for attention to the environment and the effects that other programs would have on the environment. For example, the agencies that construct or plan the construction of dams, highways, and other such projects are primarily concerned with costs and engineering feasibility. Concerns for these factors often overshadow any concern for the projects' environmental effects, which are usually harder to estimate.

Effective management becomes increasingly more difficult as the programs increase in size and complexity. The interrelationships in the environment have added further to this problem.

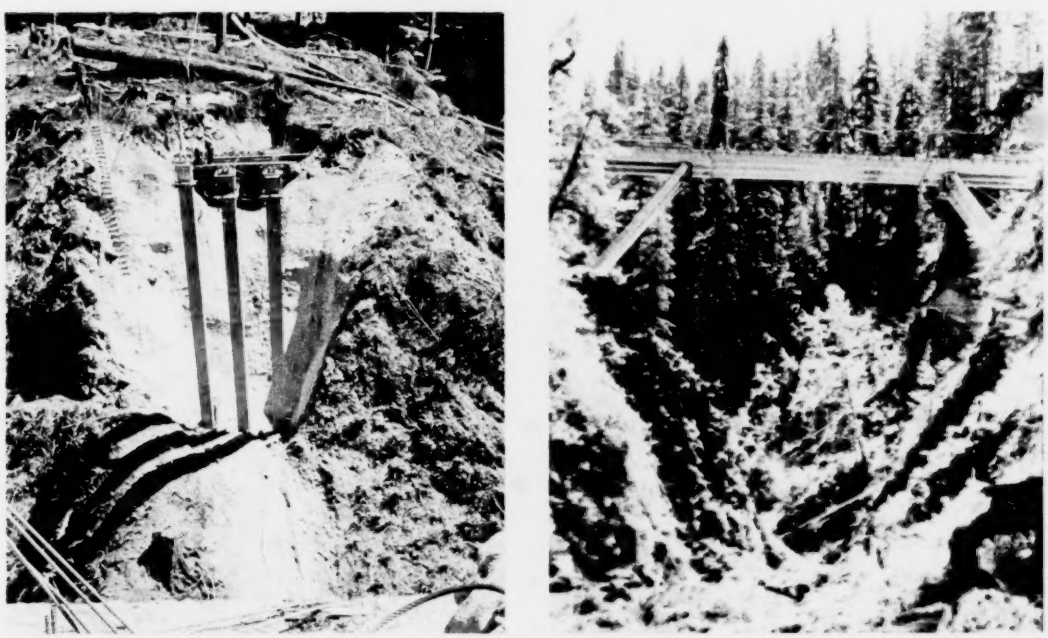
In May of 1969, President Nixon established a cabinet-level environmental quality council chaired by the President himself. It was still felt, however, that the executive office needed an independent organization that would be concerned exclusively with environmental problems. Such an organization would be free to look at environmental problems in new ways and proceed to deal with them. Such proposals received broad bipartisan backing from the Congress, which enacted two related measures: the National Environmental Policy Act of 1969 and the Environmental Quality Improvement Act of 1970.

On January 1, 1970, President Nixon signed the Environmental Policy Act (Public Law 91-190). That Act established a national policy on the environment, placed new responsibilities on Federal agencies to take environmental factors into account in their decisionmaking, and created a council on environmental quality in the executive office of the President. The President appointed Russell E. Train as chairman of the council.

The National Environmental Policy Act charges the council to assist the President in preparing an annual environmental quality report and making recommendations to him on national policies for improving environmental quality. It also gives the council power to analyze conditions and trends in the quality of the environment and to conduct investigations relating to the environment. The council also is given the responsibility for appraising the effect of Federal programs and activities on environmental quality (fig. 15).

This council's ability to perform its functions was significantly strengthened by passage of the Environmental Quality Improvement Act of 1970 (Public Law 91-224).

Many recent court cases seem to have favored citizens who were trying to protect the environment. There has been a considerable increase in the number of cases brought to the court by citizens trying to halt environmental deterioration.



Washington State Department of Natural Resources Photos

*Fig. 15.—Good planning before construction projects are begun can help avoid environmental problems. This bridge in Western Washington on the Solleks River was built by the Department of Natural Resources on a site chosen to minimize the impact on the natural environment.*

There are many acts now on the books that cover a variety of environmental problems and concerns. Some of these and the areas they cover will be mentioned briefly. The Fish and Wildlife Coordination Act, as amended in 1958, requires that wildlife be given "equal consideration" with other aspects of water resource development. It further requires that the Department of Interior's Fish and Wildlife Service and State wildlife agencies be consulted prior to project approval in cases of water resource development.

The Wilderness Act establishes a national wilderness preservation system for Federal lands and legally protects that system against development. The Act itself puts certain Federal lands within the system and allows for inclusion of other land after future reviews.

The Federal Power Act requires the Federal Power Commission to ensure that any dam or related project for which it issues a license be adapted to a comprehensive plan that considers commerce, waterpower, and "other beneficial public uses, including recreational purposes." Other Federal regulations and legislation now include such things as development of highways and airports, air pollution under the clean air amendments of 1970, and many provisions for clean water.

The clean air amendments of 1970 are an interesting example of a recent shift in the burden of proof in pollution control. In the past, the Government has generally had the burden to prove when the environment was being polluted. Under the clean air amendments of 1970, the administrator of the EPA may indicate that an air pollutant is hazardous, and then, after giving notice, may publish emission standards. Emission standards would be the amount of material that can be put into the air. Under this procedure, any objector must establish "that such a pollutant clearly is not a hazardous air pollutant."

Bills are being proposed that would regulate ocean dumping. Another bill is being proposed to control toxic substances. Congress has enacted into law the policy of greater control of pollution from Federal facilities. It amended both the Federal Water Pollution Control Act and the Clean Air Act to bring Federal facilities into line with these quality standards.

Citizens and citizen groups have obtained increasing opportunities to participate meaningfully in Federal agency decisionmaking. Many agencies in the process of decisionmaking have expanded the numbers and types of hearings in which citizens are involved. The courts have quite consistently broadened the authority of citizens to review an agency's decisions in court.

Laws by themselves cannot achieve environmental quality. Improved environmental quality will come only through the concerted use of economic, scientific, and management tools, along with application of law. There are, however, many encouraging developments in new legislation as well as voluntary compliance and, in some cases, enforcement of these laws.

## International Cooperation

Environmental problems do not stop at national boundaries. Air pollutants, whether they be billows from smoke stacks, ash and smoke from burning forestry or crop residues, or sand and silt picked up by the wind, can all cloud the air and settle in another country. Effluents flowing into an international river can kill fish in a neighboring nation, and can greatly lessen the quality of that water and eventually pollute international seas. Because of these factors, international cooperation is necessary on many environmental fronts.

Problems such as oil spills from tankers at sea require international cooperation both for prevention and for cleanup.

Air and water pollution are not the only environmental problem that will require international cooperation. Some of the world's resources, such as sea bed minerals and ocean fish, can be wisely dealt with only through international agreement. What nations do to clean up their own pollution can affect international commerce. The costs of pollution control and other environmental measures can change the competitive position of a nation's industry. The methods that a nation uses to regulate international transportation and imports in order to eliminate sources of pollution can also have considerable effect on trade. Some of these factors must receive increasing attention in setting international trade policy. It is possible, however, for nations to save money and improve foreign relations by working together on research and sharing environmental information with each other. Environmental studies in one country can almost always be useful in several other countries.

The National Environmental Policy Act directs all agencies of the Federal Government to recognize the worldwide and long-range character of environmental problems. While being consistent with foreign policy, it directs the agencies to support international cooperation and prevent a decline in the quality of mankind's environment.

The United States has been engaged in international cooperation on environmental and other matters through a variety of channels. These include the United Nations and its specialized agencies as well as numerous other intergovernmental organizations. The United States also works with numerous nongovernmental organizations.

The United States is cooperating with several of the specialized organizations within the United Nations. The Economic Commission for Europe is working on air and water pollution control, urban development, and exchanges regarding government policy problems. The Commission is made up of European members of the United Nations plus the United States.

The Inter Governmental Maritime Consultive Organization has worked to encourage an exchange of research and information on the rapid, safe, and workable handling of oil spills and other aspects of ocean pollution. It has established international mechanisms for reporting oil spills.

The U.N. Educational, Scientific, and Cultural Organization (UNESCO) promotes scientific investigation of man-induced and natural changes in the character of the oceans. It has supported programs to identify the effects of waste disposal at sea and to prevent depletion or extinction of valuable marine species because of man's activities. UNESCO has also sponsored studies of atmospheric pollution.

The World Health Organization (WHO) conducted studies of coastal pollution and is planning to lend technical guidance on coastal water quality and ways of preventing pollution. WHO is developing a worldwide program of monitoring certain environmental conditions that directly affect health.

The Food and Agriculture Organization (FAO) is undertaking studies on water quality criteria for fish, on pesticides and pollution, on pulp and paper mill effluents, and on sewage effluents. The FAO has been concerned primarily with inland waters but is also doing some monitoring and management of the sources and effects of pollution on the ocean fisheries. FAO also conducts surveys connected with land use, stressing increased productivity in management of natural resources, particularly in developing countries. FAO has programs in wildlife management, in tourist development, in protein production, in national park development, and in traditional agricultural and forestry areas (fig. 16).

The World Meteorological Organization (WMO) has launched the world weather watch to improve the collection of meteorological data for forecasting and for studies of atmospheric pollutants. Research is being promoted and studies are being made of the meteorological factors involved in air pollution.

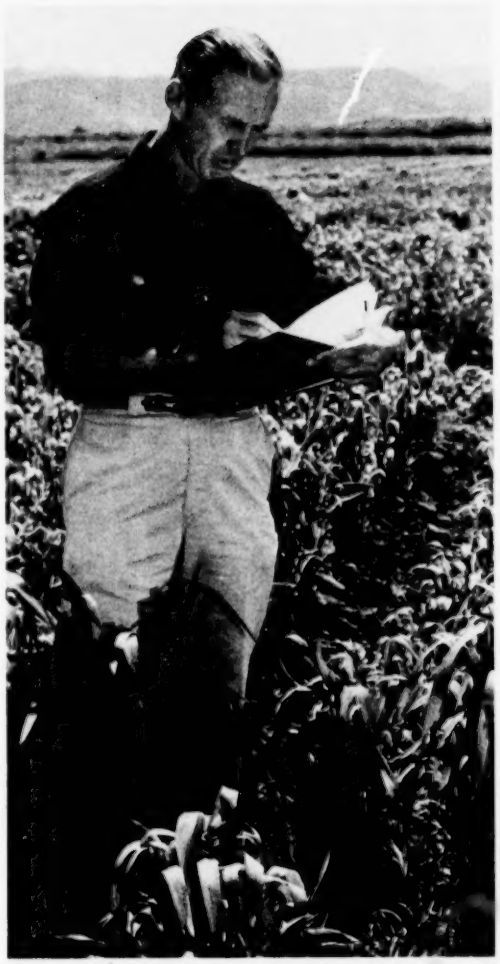
The International Atomic Energy Agency (IAEA) concentrates its environmental activities on pollution from radioactive substances. In cooperation with the World Health Organization and UNESCO, it has set up a worldwide sampling network to measure the amount of radioactivity and precipitation and is working on techniques for measuring atmospheric and other environmental radioactivity.

The U.N. Conference on Human Environment was established by the United Nations and convened in Stockholm, Sweden, in June 1972. The agenda for the conference covers a wide range of topics. The following fundamental purposes for this conference were agreed to by the General Assembly of the United Nations.

To focus attention of governments and public opinion on the importance and urgency of environmental problems, both in developed and developing countries.

To provide a forum for exchange of views among governments on ways of handling environmental problems, including legislative and administrative action.

To identify environmental problems which can only, or can best, be solved through international or regional cooperation.



USDA Photo

*Fig. 16.—Nobel Prize winner Dr. Norman E. Brolaug is shown recording the vigor and state of wheat growth in his breeding plot.*

To consider methods or meet the need for intensified action at the national, regional, and international levels—especially ways in which the developing countries can minimize or forestall the adverse effects of industrialization and urbanization.

To encourage wider participation and support for the environmental activities and programs of U.N. bodies and other international organizations and to help give them a common outlook and direction.

Other intergovernmental bodies, such as NATO and its Committee on Challenges of Modern Society in 1969, had eight pilot studies underway. Five of these pilot studies had two or more of the member countries working together.

The Organization for Economic Cooperation and Development has active programs on water resources management, air pollution, and pesticides. The Organization of African

Unity, Organization of American States, and Council of Europe all have been working to improve environmental quality. The United States is also cooperating with many countries in joint research and information sharing.

## PRESENT AND FUTURE ENVIRONMENTAL NEEDS

Progress toward combating environmental decay has speeded up rapidly in the past few years. Although progress is being made, much remains to be done. To solve tomorrow's problems we will need to know much more than we know today. We lack scientific data about how natural forces work on our environment and how pollutants alter our natural world. We will have to improve on our ability to innovate in developing solutions. Monitoring all areas of the environment will help us determine whether our environment is improving or deteriorating. Above all, we will have to agree on some basic concepts so that solutions can be developed.

We need a better understanding of environmental problems and what to do about them. We need a better understanding of what procedure to follow when we find conditions that are not what we feel they should be.

Many of the problems in the environment are products of the values we hold. People generally agree that a river should not be polluted. Therefore, when they see a polluted river they feel pollution is a problem. Many of the values that affect the environment are not so unanimously agreed upon. It is not uncommon for even those of us who profess an interest in the environment to live in a big home on a big lot, thus contributing to greater pollution problems. We may cause further problems through our recreational activities. We may own a boat that interferes with fish and other wildlife (fig. 17). We may own a snowmobile that again may interfere with wildlife or even the neighbor's peace and quiet. If we are sportsmen, some of our hunting and fishing activities may not be constructive to the overall improvement of wildlife.

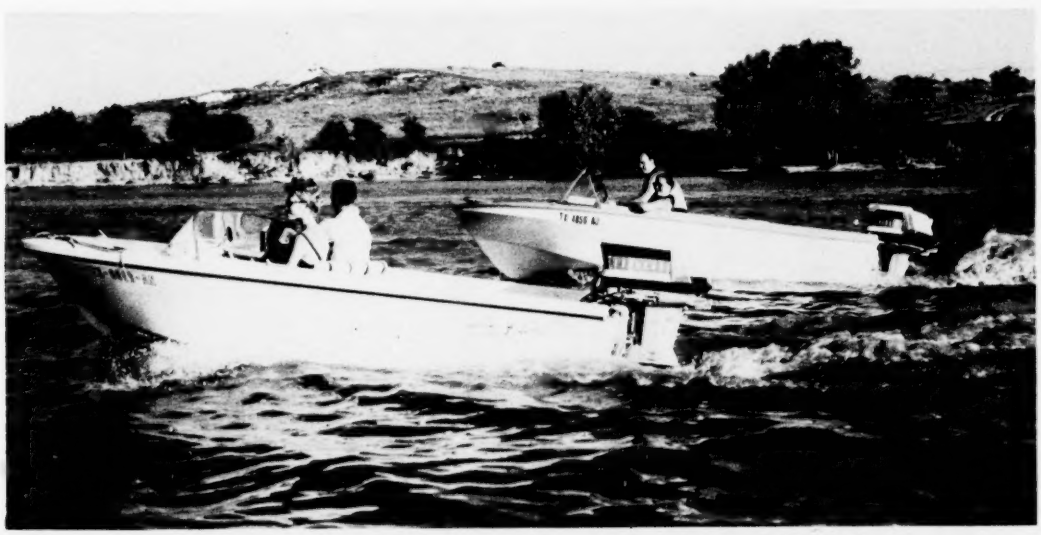


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*Fig. 17.—What effect do these boats have on the total use of this lake?*

Our ignorance of the interrelationships between separate pollution problems is a handicap in devising control strategies. We need to find answers to questions like the following: Is pollution directly related to population, to land use, or to resources? Can we talk about pollution in general or must we deal with a series of particular pollution problems such as radiation, pesticides, and solid wastes? Most persons can agree that we need to look at many of these at once, but we still have to decide which ones we will include and how we will go about it. Because of the intercomplexities of the problems involved in the environment, many of these questions are difficult to answer.

Stronger governmental institutions will be necessary to deal with environmental problems. It is necessary that governments at all levels be changed to cope with and solve environmental problems. Many changes in government will be required for the comprehensive and coordinated efforts needed to improve environmental quality. Changes in government that are being made at present are more likely a base or beginning rather than a final answer in solving environmental problems.

Although coordination often will have to be done by the Federal Government, States will play a key role in environmental management. States often cover sizeable geographic areas and have broad legal powers that can be used in working on environmental problems. Many States are working with municipalities to build sewage treatment plants and to coordinate treatment for the entire State. Some States are working on air pollution standards and control, land-use control, and comprehensive planning to improve other pollution problems.

The local government is often the one that has to carry out an action program of environmental improvement. This is particularly difficult at this time when fragmentation has divided the resources, and the demand for public services is rapidly increasing while the sources of tax income rise relatively little. With these problems already facing local governments, a look at the financial burden of environmental improvements may be enough to invite a wholesale resignation of the city council. Therefore, financing the improvement of environmental quality needs to be greatly changed.

Liquid and solid waste collection and disposal by local governments represent a necessary service. Oftentimes users of these services, such as industry and home owners, do not bear the full cost of operation of such services. This means that financially troubled local governments are subsidizing these services. This uses the local government's operating monies. These monies are usually needed to maintain waste disposal facilities properly and, thus, the method of funding contributes to poor performance in treating sewage and disposal of solid wastes. It also encourages a greater production of waste by industries because they do not bear the full cost of disposal.

We need better pollution control curbs. In the past, most of these have been regulatory. There is presently considerable debate as to whether regulation represents the best course of action. One alternative being suggested is that of economic incentive. Another alternative being suggested is the implementation of a charge or tax on the volume of pollutants, say 10 cents a pound on oxygen-demanding material. Some feel that the charge systems would not only be more economical, but would also be more effective in producing the desired results.

To do an effective job of improving the environment and controlling pollution, more and better monitoring and research needs to be done, both in the United States and internationally. We need information on the current status of the environment and on changes and trends in its condition (fig. 18). We also need information on what these changes mean to men. Without this type of information we can only react to environmental

USDA Photo

*Fig. 18.—This monitoring device uses a pillow filled with 250 gallons of methanol that is connected to instruments in the little house. This measures the amount of snow.*

problems after they have become serious enough for us to see. Such ignorance prevents us from developing long-term preventive strategies and lowers our ability to anticipate problems in advance. For example, we became aware of the mercury problem only after it had become critical in some areas. A better monitoring system would have given us an earlier warning to which we could have reacted by taking action to stop pollution and its sources.

Another serious problem is our lack of information as to what low-level exposure to most pollutants will do to man's health over a long period of time. We know little of how people react to changes in their environment. The social sciences will have to develop new

gages to measure environmental stress. We need to determine what crowding, urban noise, and automation do to man. We need to develop an understanding of the interactions of different environmental forces such as urbanization, land use, and pollution. We also need to develop an understanding of many of the natural processes that play critical roles in environmental well-being such as changes in the world climate.

The first step in monitoring is to identify the items that we should measure. These may include substances such as DDT, sulfur dioxide, mercury, and lead. These items may also be the percentages of open space in cities, the use of parks, the survival of species, or changes in values. Once the areas to be monitored have been identified, they must be measured on a regular, repeated, and continuing basis. In this way, we can determine the present status and, from that, any future changes required.

Based on such information, environmental indices can be developed. Indices are data put together so as to provide a picture of some aspects of environmental quality. An example would be the quality of air as it affects human health. Good indices show the current environmental quality and also whether this condition is improving, staying the same, or deteriorating.

Although many monitoring and information systems exist at the Federal, State, and local levels, there has been little coordination, thus making the information of limited value for program purposes or for scientific understanding. The information is in small fragments often collected on different bases and, thus, not comparable on a nationwide basis.

With our present knowledge of environmental problems, it is very difficult to determine long-range priorities. Relevant measures of environmental quality are often not available or are inadequate. Further difficulties are encountered because of the differences between regions. The information presently available can be used to identify pressing problems for immediate action. As soon as possible, however, long-term priorities need to be developed. The amount of resources available for improving the environment are limited so that the sooner choices can be made the better these limited resources will serve to improve environmental quality.

Setting priorities is not easy. There are widely varying views as to which are the most important problems. There are conflicts between the needs of industry and the needs of the environment. While many citizens may clamour for improved environment, they may at the same time demand more conveniences. The priority set by the Federal, State, and local governments may not always coincide with one another. Urgent local problems may cause a local government to set a priority quite different than that which is most pressing for the Nation as a whole. Even while understanding all these problems in setting priorities, we can still understand that priorities must be set at every level to achieve real progress toward a high-quality environment.

The Council on Environmental Quality has listed the following as the four main criteria that should determine priorities:

> The intrinsic importance of the problems—the harm caused by failing to solve them.
>
> The rate at which the problems are going to increase in magnitude and intensity over the next few years.
>
> The irreversibility of the damage if immediate action is not taken.
>
> The measure of the benefits to society compared to the cost of taking action.

After priorities have been determined, policies must be formulated to carry the priorities into action. Such policies may consist of activities aimed at a particular goal. Policies need to be developed with imagination to carry out priorities to the best of our knowledge. Policies need to be developed as soon as priorities have been determined so that action may be taken as soon as reasonably possible.

Even after proper priorities have been set and policies consistent with these priorities have been developed, environmental harm cannot be wholly averted. Setting priorities and developing policies can, however, limit the damage that is done. In the short run, we will likely have to continue to use the development of power-generating facilities and transmission lines that are only somewhat better planned and controlled than in the past. Long-range planning can, however, set national energy policy based on a comprehensive analysis of energy resources and actual needs. Such a policy will provide for wise use of fuels that will both conserve them for the future and lessen environmental damage. This will likely require wider use of nuclear fuel, natural gas, and low-sulfur coal and oil to lower sulfur oxide levels, particularly in high-population areas. Improved technological methods may also improve our efficiency of burning such fuels and allow us to remove some of the harmful particles such as sulfur oxides before they are released into the air (see table 1).

National transportation policies may include better enforcement of emission standards and control devices for individual vehicles as well as other technological solutions. These, however, may not be enough in combating the problems of increased numbers of automobiles, especially in cities. As part of the transportation policies, continued studies on curbing auto emissions and alternate methods of transportation will be studied.

Land-use policies have been shown to be a critical need in the 1970s. Many present land-use policies are set by local governments. Many of these policies are piecemeal and haphazard. The local property tax favors a single-family residence on a large lot over types of housing less wasteful of land. Land-use planning has often failed to take into account the impact of construction and development on natural surroundings. It is a combination of many of these factors that has led to a series of local zoning decisions and regulatory action that has expanded urban sprawl.

The role of State governments in land-use control has been relatively small since the authority has been delegated to local governments. The role of the Federal Government in controlling local land use has been even smaller. The Federal Government does have several ways in which it can plan for and influence land use. Many people are now beginning to demand that a greater role be taken by State and Federal Governments and that they work together for a national land-use policy.

Both population and economic growth are potential sources of environmental decay. They increase the demand on natural resources. Indications are that the U.S. population will continue to grow for the next few decades. Such population growth will make it difficult to achieve improved environmental quality.

As knowledge of the environment and various problems increase, new priorities will doubtless be identified. The establishment of these priorities will make it necessary to develop policies at the local, State and national levels. Specific programs for the implementation of these policies must then be formulated. The accomplishment of some of these priorities will require international cooperation, as has previously been discussed.

*Table I.—Annual Average Level of Selected Air Pollutants in Selected Cities*

| Location and pollutant ($mg/m^2$) | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 |
|---|---|---|---|---|---|---|---|
| Chicago: | | | | | | | |
| $SO_2$ | 282 | 393 | 458 | 341 | 215 | 327 | 307 |
| $NO_2$ | 81 | 77 | 87 | 81 | 105 | 94 | 90 |
| CO | [2] NA | 9,430 | 13,915 | 19,665 | 14,375 | 10,120 | 7,130 |
| Cincinnati: | | | | | | | |
| $SO_2$ | 92 | 68 | 100 | 79 | 81 | 55 | 44 |
| $NO_2$ | 56 | 56 | 60 | 66 | 68 | 53 | 60 |
| CO | NA | 8,050 | 7,015 | 4,600 | 5,635 | 6,440 | 6,440 |
| Denver | | | | | | | |
| $SO_2$ | NA | NA | NA | 55 | 29 | 13 | 34 |
| $NO_2$ | NA | NA | NA | 68 | 64 | 70 | 68 |
| CO | NA | NA | NA | 8,280 | 9,085 | 8,740 | 6,210 |
| Philadelphia: | | | | | | | |
| $SO_2$ | 231 | 181 | 215 | 223 | 238 | 257 | 212 |
| $NO_2$ | 73 | 71 | 71 | 68 | 73 | 81 | 73 |
| CO | NA | NA | 8,165 | 9,315 | 7,820 | 7,245 | 9,890 |
| St. Louis: | | | | | | | |
| $SO_2$ | NA | NA | 155 | 123 | 113 | 76 | 73 |
| $NO_2$ | NA | NA | 62 | 64 | 64 | 45 | 43 |
| CO | NA | NA | 7,245 | 7,475 | 5,670 | 6,440 | 5,270 |
| Washington, D.C.: | | | | | | | |
| $SO_2$ | 144 | 131 | 126 | 121 | 115 | 126 | 97 |
| q $NO_2$ | 56 | 66 | 68 | 66 | 66 | 81 | 88 |
| CO | 6,095 | 7,705 | 6,555 | 4,255 | 3,795 | 5,635 | 3,910 |

Note—Data for 1969 and 1970 not available until December 1971 because of change in computer processing methods.
NA—not available.

Source: *Environmental Quality: The Second Annual Report of the Council on Environmental Quality.*

## SUMMARY

It now appears as if people may look back in history to the 1970s and say that that was the time when people became aware of many environmental problems. Environmental qualities and ways of solving environmental problems are being looked at in different ways. The public has become aware of the deteriorating environment, and both public and private resources are being committed to help in solving the problems.

While the awareness of environmental problems has spread to the general public and while work on many environmental fronts has been started, much remains to be done in improving environmental quality. Although our present knowledge may still be very limited and our institutions not fully geared up for working on environmental problems, we can do more than we are now doing. For the long term we need to gain considerable information. Some of the information and knowledge that we will need to gain is in the area of values. The fact that people are often inconsistent in their value systems makes this a difficult area to work on. We will need to learn more about the kind and seriousness of environmental

problems. We need to find, not only the present status of the problem, but also the trends in environmental problems. We will need to learn more about the workings of natural processes and also the effects of pollutants on man, animals, vegetation, and materials. As knowledge and information are accumulated, financing and institutional mechanisms, priorities, policies, and, above all, action programs will have to be carried out. A systematic approach is necessary or we will likely continue our present somewhat unorganized efforts and will achieve only partial and unsatisfactory progress in solving environmental problems.

Because of interdependency within the environment, changes in one part of the environment inevitably trigger changes in other parts. These complex interactions require that the environment be looked at as a whole. Decisionmakers need to see a broad picture in order to be able to make the proper decision. Such decisionmakers must also realize that there are not enough resources to accomplish everything, so priorities must be set.

Even while realizing the importance of looking at the environment as a whole to understand the inner complexities of environmental processes, we also must recognize the need for specialized knowledge. Because of the large number of areas involved in the environment, it is impossible for one person to have in-depth knowledge of all these areas. This means that, in solving a particular problem, specialists may have to be called in to work with the decisionmakers, helping to supply the specific facts on which the decisions should be made. For example, it is unlikely that a person with a good general understanding of environmental problems would be the person to call in for specific information on what needs to be incorporated into a noise ordinance for a particular community.

Water pollution caused by a specific source may affect an entire ecosystem. Enforcement action, however, must be taken against a particular source. Much of our attack on environmental decay has necessarily focused on separate and identifiable environmental problems. This has mainly been due to the fact that we do not have informed decisionmakers who can consider the environment as a whole in solving problems at this time. Legislation such as this emphasizes that environmental values must be considered along with technical and economic values. The long-term as well as the short-term consequences must be given careful consideration. Irreversible reactions and commitments must be weighed carefully. More and more of these governmental decisions are being discussed with advisory committees that contain people who are environmentally knowledgeable and can sometimes visualize problems that have at times been overlooked in past planning.

It has often been said that the only sure things in life are death and taxes. It is now beginning to look like we will have to add pollution to this statement as one of the sure things in life.

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